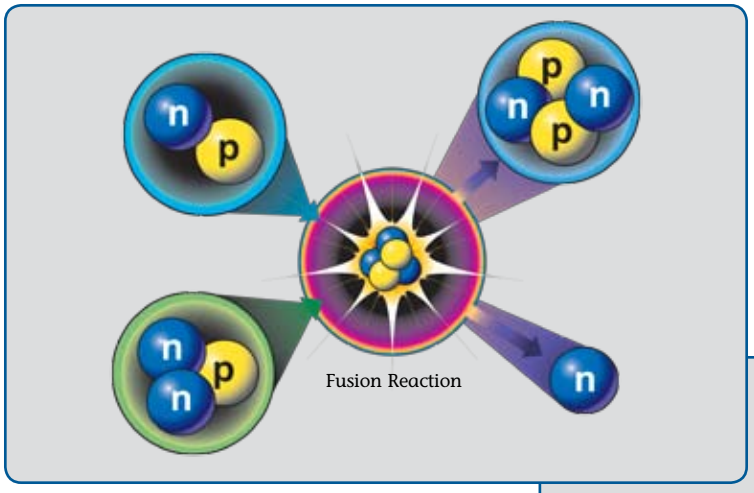
NIF
National Ignition Facility

The Promise of Limitless Energy

Harnessing the energy of the sun and stars to meet the Earth's energy needs has been a decades-long scientific and engineering quest. While a self-sustaining fusion burn has been achieved for brief periods under experimental conditions, the amount of energy that went into creating it was greater than the amount of energy it generated. There was no energy gain, which is essential if fusion energy is ever to supply a continuous stream of electricity. If it is successful, the National Ignition Facility will be the first inertial confinement fusion facility to demonstrate ignition and a self-sustaining fusion burn. In the process, NIF's fusion targets will release ten to 100 times more energy than the amount of laser energy required to initiate the fusion reaction.



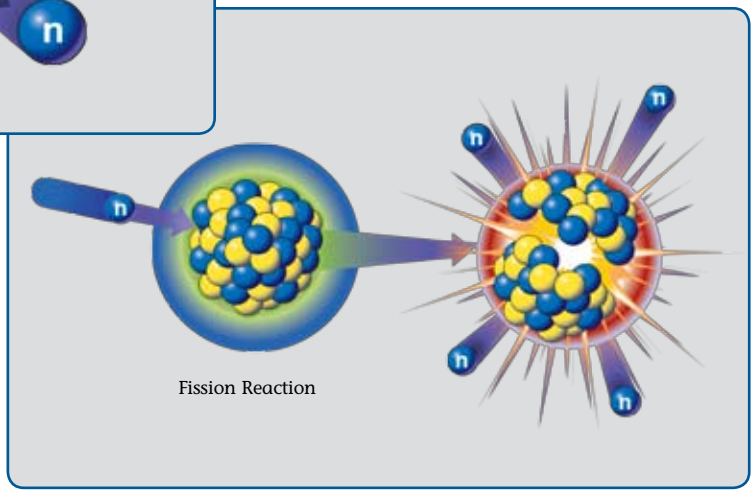
Fusion Reaction

The nuclear power plants in use around the world today utilize fission, or the splitting of heavy atoms such as uranium, to release energy. A fusion power plant, on the other hand, will generate energy by fusing atoms of deuterium and tritium – two isotopes of hydrogen, the lightest element. Deuterium can be extracted from abundant seawater, and tritium will be produced by the transmutation of lithium, a common element in soil. When the two atomic nuclei overcome their natural tendency to repel one another and fuse under the intense temperatures and pressures in the NIF target capsule, a helium nucleus is formed and a small amount of mass lost in the reaction is converted to a large amount of energy according to Einstein's formula $E=mc^2$.

A fusion power plant would produce no greenhouse gas emissions, can operate continuously to meet demand, and would produce shorter-lived and easier-to-store radioactive by-products than current fission power plants. A fusion power plant would also present no danger of a meltdown.

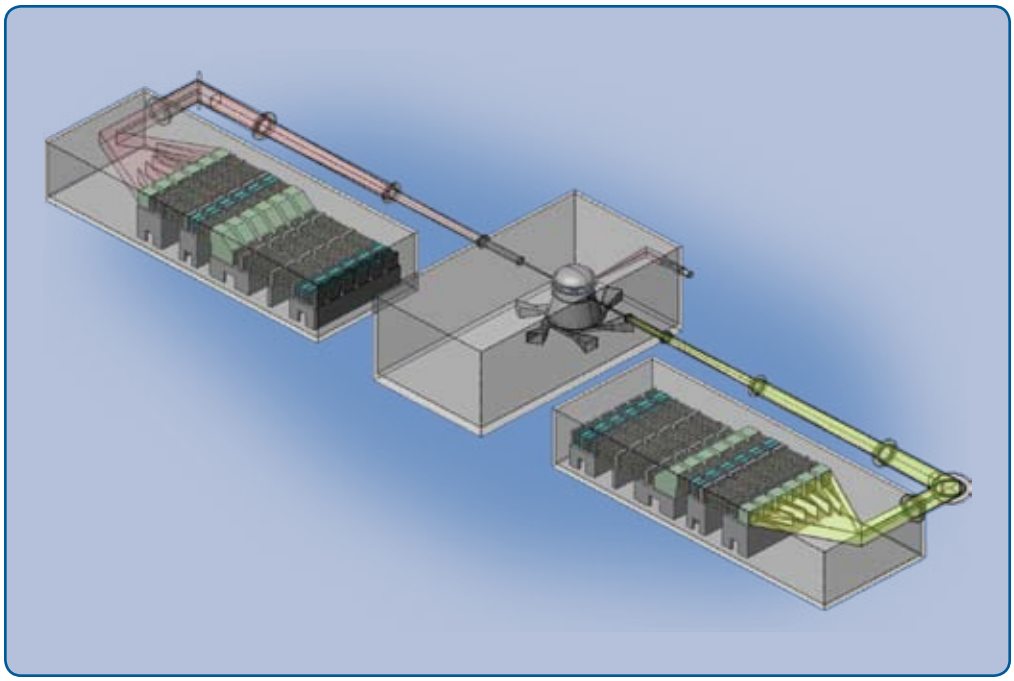
Because nuclear fusion offers the potential for virtually unlimited safe and environmentally benign energy, the U.S. Department of Energy (DOE) has made fusion a key element in the nation's long-term energy plans.

NIF is designed to produce fusion burn and energy gain using a technique known as inertial confinement. NIF's intense laser beams, focused on a tiny target filled with deuterium



Fission Reaction

LIMITLESS ENERGY



Fusion Power Plant
An artist's concept of a future inertial fusion power plant.

and tritium, will create temperatures of tens of millions of degrees and pressures more than 100 billion times Earth's atmospheric pressure. When the fuel core reaches 20 times the density of lead and a temperature of 100 million degrees, it ignites. Thermonuclear burn quickly spreads through the compressed fuel, unlocking the stored energy of the nucleus.

NIF will not be used to produce electricity. Future fusion power plants will have to be firing at several targets per second for significant power production. But NIF experiments will bring fusion energy a major step closer to being a viable source of virtually limitless energy. The timing is fortuitous. Estimates are that over the next 75 years, the demand for energy will be more than three times what it is today. ■

Electricity From Fusion
The fusing of hydrogen atoms from water in fusion power plants may someday supply almost limitless electricity.